APPENDIX TO THE FIRST AND SECOND SECTIONS OF "CONTRIBUTIONS TO PRACTICAL MEDICINE AND SURGERY."

The discovery that the animal tissues can be frozen for a short period, without risk of injuring them was of great therapeutic importance. From time immemorial the idea had existed that either mortification or violent inflammation would almost inevitably be the consequence of subjecting any part of the body to so intense a degree of cold; and this erroneous idea had, doubtless, not only prevented the well known benumbing effect of congelation from being employed to render surgical operations painless, but had also prevented the discovery, to which reasoning *à priori* would have quickly led, of the remedial efficacy in inflammatory and other diseases, of the thorough alteration in the condition of the morbid tissues caused by freezing them. Nor are these all the advantages arising from our knowledge of the innocuousness of freezing. It has removed, moreover, that fear of sloughing from this cause during the application of minor degrees of cold, which had much, and very injuriously restricted their use. The freezing of the tissues, so far from being dreaded during the application of ice in strangulated hernia, for instance, has been proved, by reports in recent medical journals, to be, when properly conducted, one of the most effectual and safe modes of reducing the intestine.

In attributing such important results to the use of intense cold—results which have been verified by the experi-

ence of twenty years—it is, of course, assumed that the process of congelation is properly executed—that its principle is applied efficiently. It was one of the purposes of the foregoing publication to remove certain misapprehensions respecting the mode of producing it which I had originally proposed; and it is the similar purpose of this appendix to notice another mode since introduced, which, though very convenient and useful in some small operations, is so defective as respects others, in which it ought not to have been employed, as to have discredited, in no slight degree, the principle of local anæsthesia. This affords some explanation of the continued announcements, from time to time, of death from chloroform, administered for operations that may always be rendered painless by congelation produced by appropriate measures.

After ascertaining the innocuousness and medical value of congelation, I had little difficulty in devising adequate means of applying it. Of the two well known modes of producing intense cold artificially—namely, the rapid solution of ice and certain salts, and the rapid evaporation of ether and other fluids—the first appeared by far the most eligible; and when I visited the hospitals in Paris in 1849, for the purpose of introducing congelation, it was produced only by freezing mixtures. Some time afterwards (1854), the other plan was adopted in one of these hospitals, and rendered more efficient by adapting to it M. Sales Giron's mode of converting fluids into spray. This plan was introduced into England about five years ago, in an improved form, by Dr. Richardson, who, by modifying the apparatus for converting ether into spray, gave it, probably, all the perfection of which its principle is capable.

Ether is valuable as a local anæsthetic under the same circumstances that it has long been deemed valuable as a refrigerant in strangulated hernia and other diseases—when ice, or a frigorific mixture made without ice, cannot be procured, it will often form a substitute for them. Certain

small operations have, on such occasions, been rendered painless by ether-spray, for which, without it, chloroform must have been employed. But of the great number of operations to which local anæsthesia is applicable, and in which the danger from chloroform ought not to be incurred, there are few in which that very handy proceeding will answer. Its principal defects, compared with a freezing mixture, are the difficulty, when an extensive and rapid incision is required, of thus freezing a large surface simultaneously and uniformly; and the difficulty of combining pressure with it, in order that, by thus promoting congelation, the intense, and sometimes injurious, degree of cold produced and required by ether-spray alone may be rendered unnecessary. In certain localities, moreover, ether will not act on account of its evaporation being obstructed, and in others its application is painful. Several writers in the *Practitioner* (vol. ii) speak of the intense suffering then produced by ether, and contrast it in this respect with ice.

Limited as the use of ether-spray is in operations, it is more so when employed as a remedy. It is said, nevertheless, to have been used with advantage in rheumatic and neuralgic affections, in head and spinal diseases, in strangulated hernia, and as a palliative in cancer. For these purposes, however, and when it is employed as a counter-irritant, a simultaneous and uniform freezing, not only of a large surface, but extending to considerable depth, and of several minutes' duration, is generally required, which is impracticable with the spray. To ensure success, a large quantity of freezing mixture must be applied, that the required degree of cold may be copiously and continuously generated, and that its weight may facilitate congelation by compressing the blood-vessels.

These imperfections, added to the difficulty of keeping the spray-producing instrument in good working order, have caused so many failures and disappointments in its use, as not only to bring this particular way of congealing

into disrepute, but they have also, though most unreasonably, thrown discredit on the principle itself of local anæsthesia. Notwithstanding the obvious injustice of condemning a therapeutical principle because one of the means of carrying it out—and probably the only means they have tried—is defective, some enthusiastic partisans of chloroform have not scrupled to do so when comparing local with general anæsthesia. A conspicuous example of this is afforded in a recent edition of a popular French treatise on operative surgery. The author of this work states that local anæsthesia by congelation has not been generally adopted, first, because the means of refrigeration are complicate; and secondly, because their anæsthetic effect is uncertain. Both of these assertions are most erroneous as respects congelation by freezing mixtures, and both are strikingly opposed to the opinion of his countryman Velpeau, the highest modern surgical authority in France, who, after fifteen years' experience of their use, spoke of them as "un moyen d'anæsthésie très simple et très efficace" (*Union Médicale* and *Gazette des Hôpitaux*, March 27, 1866).

A bit of ice dipped once or twice in salt, and slightly pressed on the skin for about a minute, congeals it, and answers perfectly in many small operations. This is the simplest proceeding in surgery, all the apparatus required for its convenient execution being a handkerchief or a glove. Nor, when required for more important operations, can a mixture of a sufficient quantity of pulverised ice and salt, applied by means of a thin gauze net; or, very neatly, when the part is in a vertical position, by means of a wide-mouthed bottle, be justly reckoned a complicate or troublesome measure. And, in regard to efficacy, a freezing mixture, properly prepared and applied, will as certainly produce complete insensibility in all operations, whether by the knife or caustic, not involving deep-seated parts, as is produced by chloroform. It is true that, as in the deeper operations, it is only the pain from cutting the skin and

subcutaneous tissues which can be prevented by congelation, it becomes a question whether the patient about to submit to such an operation should endure a slight and tolerable pain (which is all that is felt when the deep-seated parts are in a healthy condition), or, in order to obtain perfect ease, should hazard his life by inhaling chloroform. In determining this point, it would be well to recollect the inscription on the tomb of the Italian, who, not content with tolerably good health, had recourse to powerful drugs in order to render it perfect: "I was well—I wished to be better—Here I am."

When the pain from an operation can be certainly and entirely prevented by congelation, as in the forcible extraction of the great toe-nail, it is difficult to account for its not being always employed in preference to chloroform. I have adduced this instance because, notwithstanding the publication, seventeen years ago, of the details of five cases of death from chloroform given for it (which are adverted to in one of my writings on local anæsthesia of that date); and, notwithstanding the numerous reports by various surgeons in the medical journals, about the same time, of the complete insensibility in this very painful operation always produced by a freezing mixture, I find chloroform still recommended in a recent systematic treatise of great authority. Is not this evidence of the discredit into which local anæsthesia has fallen from the defective method lately employed for producing it; the distinguished author of the work alluded to clearly showing, by his remarks on the subject, that he has had no practical acquaintance with the original method?* It cannot be supposed, after the hundreds of

* Sir William Jenner, in his lately published address on the Progress of Medical Science, illustrates Local Anæsthesia by the following graphic description of its use in this particular operation: "The electric telegraph, the second greatest marvel of our time, was a thing which, in a rough way, scientific men had long thought possible; but to be cut for stone, and know nothing of the agony—to have a leg removed, and

sudden and eventual deaths which have been caused by chloroform, that he considers a substitute for it unnecessary, nor is it likely that the idea of its employment being less troublesome than that of congelation can have any weight with him. On ordinary occasions this may be so; but at other times, and particularly when the life of the patient is suspended or lost by the proceeding, more trouble and anxiety are caused by chloroform in one case of the kind than by congelation in fifty. An assistant conversant with the freezing process may, indeed, be desirable in important operations; but, from his attention not being exclusively occupied in watching the anæsthesia, as is generally the case in the administration of chloroform, his services would be available in other ways.

To complete the comparison of chloroform with congelation, the objection may be noticed which has been made to the latter, that its application is painful. Though this may be often true as respects freezing by ether-spray, it does not apply to the slight and transient tingling produced by a freezing mixture. But the greatest pain from ether would be preferred by most patients to the choking sensation often produced by chloroform—to the prostrating, and sometimes fatal, sickness which frequently follows its administration—and to the feeling that their consciousness will be lost, perhaps not to be regained in this world.

In illustration of the last of these accompaniments of the exhibition of chloroform and other general anæsthetics, reference may be made to a report in the *Standard* of the 22nd of last month, of an inquest on a death from methylene administered for the amputation of a finger. As "the brain and every other organ were found on examination *post mortem* to be in a state of perfect health", the

smilingly ask, when the operation is over, "When are you going to begin"—*to have a nail torn away, and look on and laugh while that most painful operation is proceeding*—these are marvels of which none have dreamed. No extravagance of fiction equals this reality" (page 34).

operating surgeon's opinion, formed with some show of reason, was that but for the "great nervous excitement" caused by the fears of the patient, the drug might not have proved fatal.

Two narratives, lately published in two opposite pages of the *Lancet* (444 and 445, vol. ii for 1870), and affording a singular contrast to each other, may be also referred to here, as they illustrate some other of the above remarks. One is the report of a death from chloroform given for the amputation of a finger; the other a detailed account by Dr. Angus of the amputation of the forearm under congelation produced by ice and salt. The first shows, as in the case of death from methylene just related, the surgeon's loss of confidence in local anæsthesia, arising probably from his having attempted to produce it on other occasions exclusively by ether-spray, for no proceeding can be more simple and certain than the benumbing of a finger by dipping it for a few seconds into a semifluid mixture of ice and salt; the second exemplifies the applicability (adverted to in page 7) of local anæsthesia produced by similar means to the larger as well as to the smaller operations. The amputation was performed on a man of middle age "whose nervous system (it is stated) was shattered by long continued suffering". After removing the gauze bag containing the freezing mixture which had been placed round the limb, Dr. Angus "waited a little until the rigid frozen surface began to yield to the heat remaining at greater depths, when the knife was introduced and the operation proceeded with, causing very little pain to the patient, and with such relief to his mind, that he began to converse on some topic of the day before it was finished". . . . "The system received no shock whatever; the wound healed without any untoward symptom, and the general health improved rapidly afterwards."

After stating the insufficiency of ether for such an operation as that described, the report concludes with the following among other remarks, which deserve particular atten-

tion as coming from one who had himself used both modes of producing congelation:

"The freezing mixture is much more convenient and manageable than ether-spray, and can be applied with greater topical precision. It has not to depend upon a carefully adjusted apparatus being properly worked, or upon the purity of a delicate chemical compound, but will always do its allotted task quickly and without fail. With the spray, although that portion of the skin where evaporation is most rapid, is quickly reduced to a state of insensibility, the neighbouring surface, which in all cases cannot be shielded, is also gradually robbed of its caloric, and is very painfully alive to the process. On the other hand, neither more nor less of the exact surface required is exposed to the influence of the freezing mixture, and every point of that surface receives simultaneously the full effect of the anæsthetic."

There are other modes of employing the cold produced by a freezing mixture besides its direct application to the part to be congealed, which are mentioned in my writings on local anæsthesia, but as they are only suitable on particular occasions, it would be foreign to the purpose of this appendix now to describe them. As they extend the sphere of anæsthetic congelation, those surgeons should have knowledge of them who deem it unjustifiable to hazard life by administering chloroform in operations which can thus be rendered painless with perfect safety.

June 23*rd*, 1871.